# Enzyme-extracted Pectin as a Clean Label Emulsifier for Improved Stability of Oil-in-Water Emulsions

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## Introduction

- Okra pectins (OKP) have excellent gelling, stabilizing, and emulsifying properties, making them promising for use in the food industry.
- Acid extraction is the common method used to obtain commercially available pectin, but using enzyme extraction could be a suitable alternative to produce pectin with a clean label.
- Previous studies have shown that the emulsion activity and stability of OKP are influenced by its molecular structure.
- The main structural factors influencing OKP's stability include its hydrophobic components (protein, acetyl, and methyl groups), neutral sugar content, and backbone composition (HG: RG-I). However, our understanding of these relationships is limited.
- To gain a better understanding of how the molecular structures of OKP affect its emulsifying stability, we conducted enzyme-assisted extraction using various cell wall hydrolytic enzymes to produce OKP samples with diverse macromolecular structures.
- Principal component analysis was employed to establish a reliable relationship between the structure and function of OKP.

## Methodology

- Five (5) commercial enzymes namely Peclyve CP (A. niger), Rohament CL (Modified Trichoderma reesei strain.), Peclyve UF Plus, Peclyve FR Acid, and Peclyve PR were purified from A. niger., expressing different pectinase activities obtained from Bision enzymes, Korea (http://bision.co.kr).
- 5 okra pectin samples (CP, CL, UF, FR, and PR) were extracted using enzyme extraction conducted in a reaction incubator at 55oC, 2 h, and 150 rpm. Pectins were precipitated using 3-vol of ethanol and lyophilized.
- Emulsion tests and macromolecular properties of pectins were carried out using standard methods.

## Results & Discussion

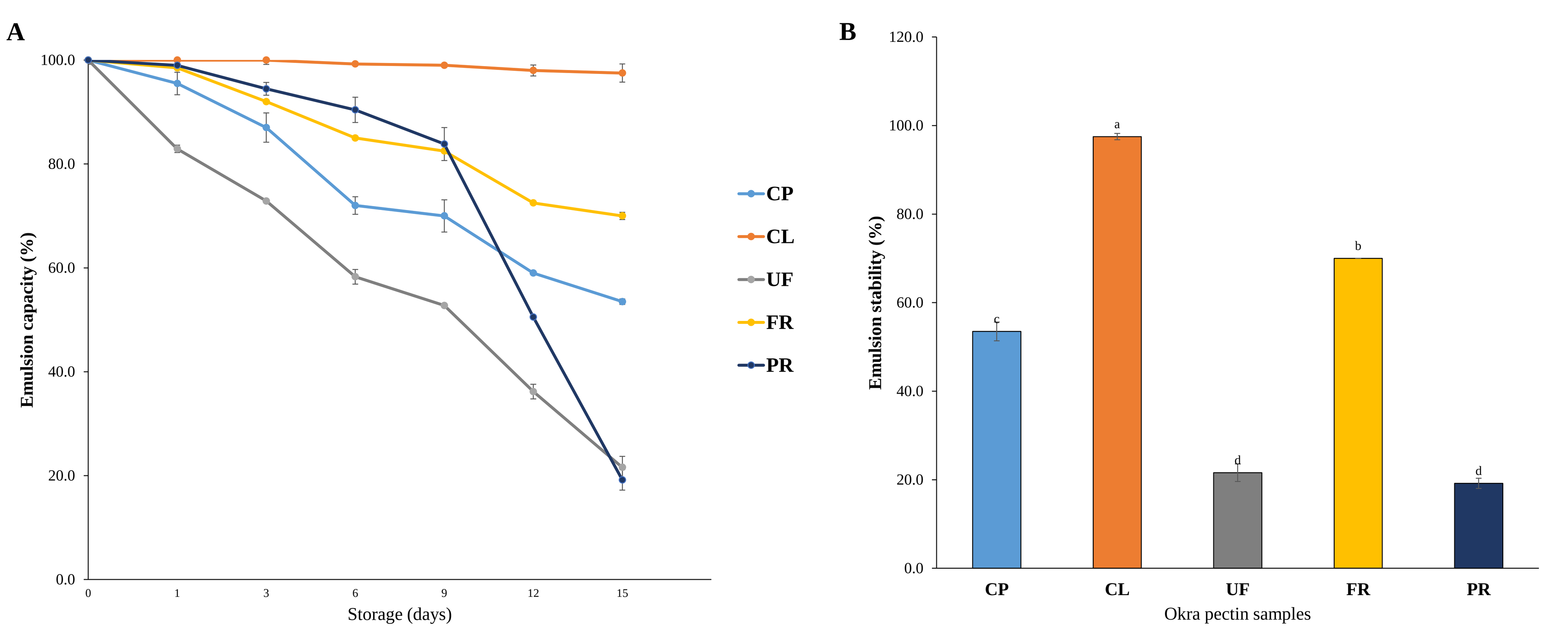


Fig.1 Emulsion capacity during 15 days storage (A) and emulsion stability (ES) using a centrifugal test (B).

- CL showed better emulsion stability compared to other pectins

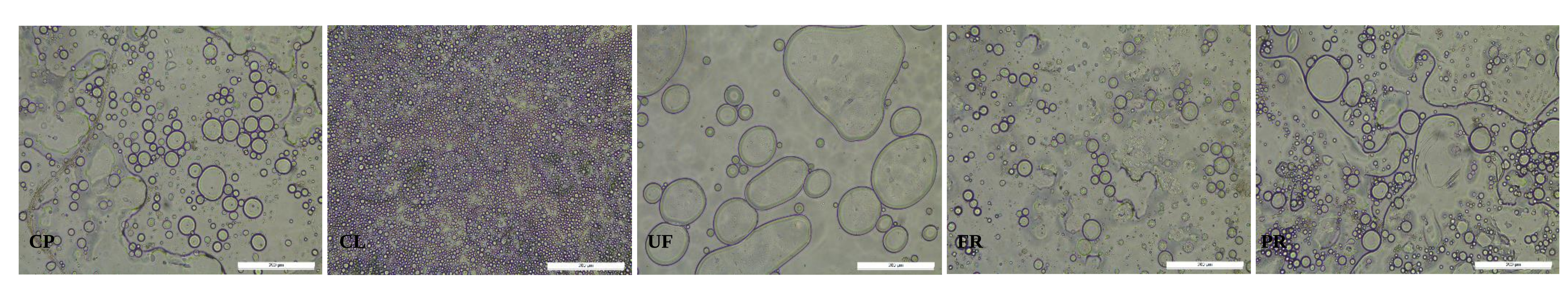


Fig. 2 Morphology of emulsions stabilized using okra pectin extracted by different enzymes

- Emulsion droplet size is directly related to emulsion stability. CL showed small and uniform droplet sizes compared to other pectin samples.
- Also, more oil droplets were encapsulated by CL pectin. This explains the higher emulsion stability of CL, as also seen in Fig 1.

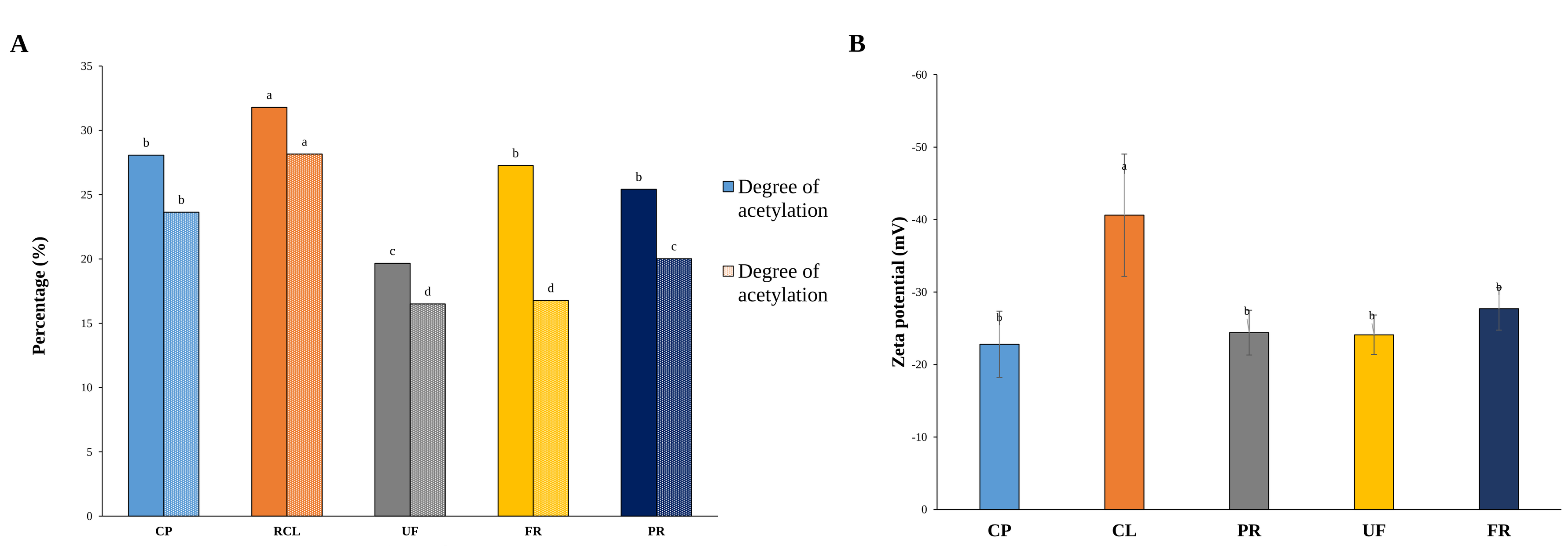


Fig. 3 Degree of acetylation and methylation (A) and Zeta potential (B) of okra pectin extracted by different enzymes.

- CL had a significantly ($p<0.05$) higher degree of acetylation and methylation and also a higher (-40.6 mV) zeta potential value (Fig. 3A).
- Acetyl and methyl groups are present in pectin as hydrophobic groups, which improves the interfacial activities of pectin.

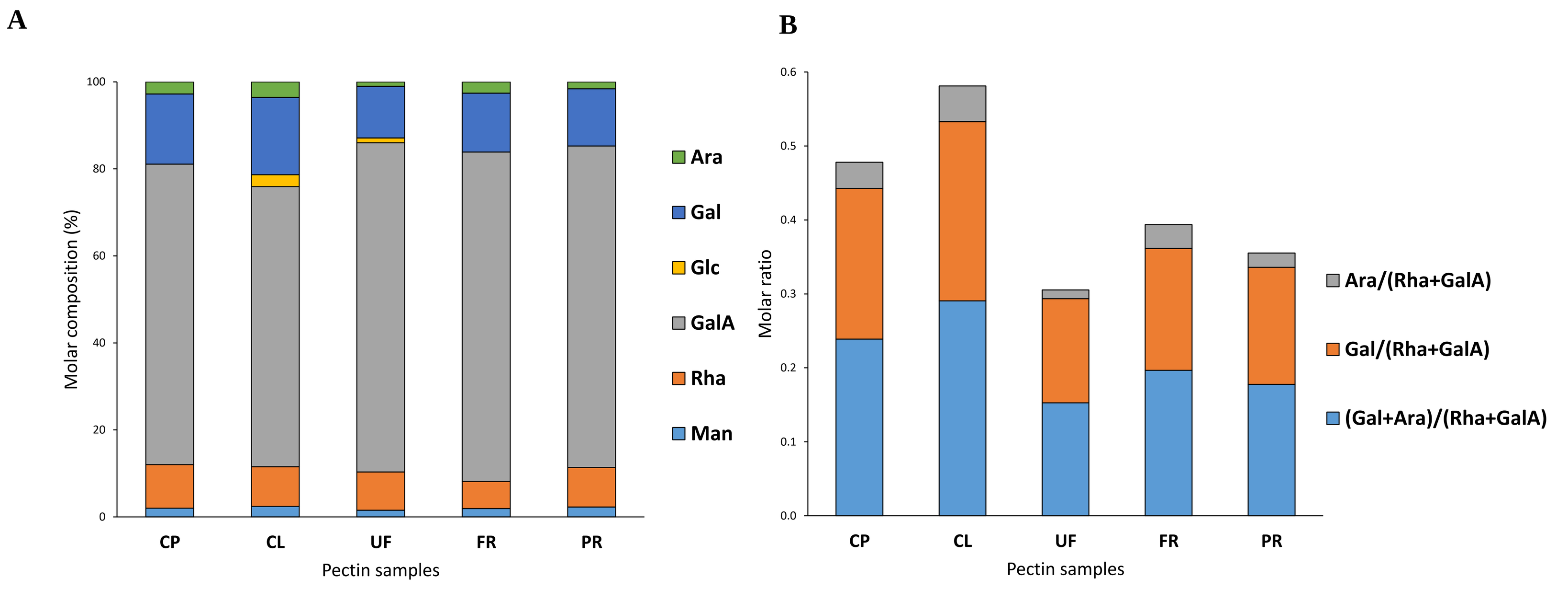


Fig. 4. Monosaccharide composition (A) and the molar ratio of side-chain sugars (B) of okra pectin extracted by different enzymes

- The percentage molar composition of sugars varied according to enzyme type (Fig. 4).
- CL had the highest molar ratio for side-chain sugars (Gal and Ara).
- The higher composition of side-chain sugars in CL pectin structure could be related to its higher emulsifying properties

## Conclusion

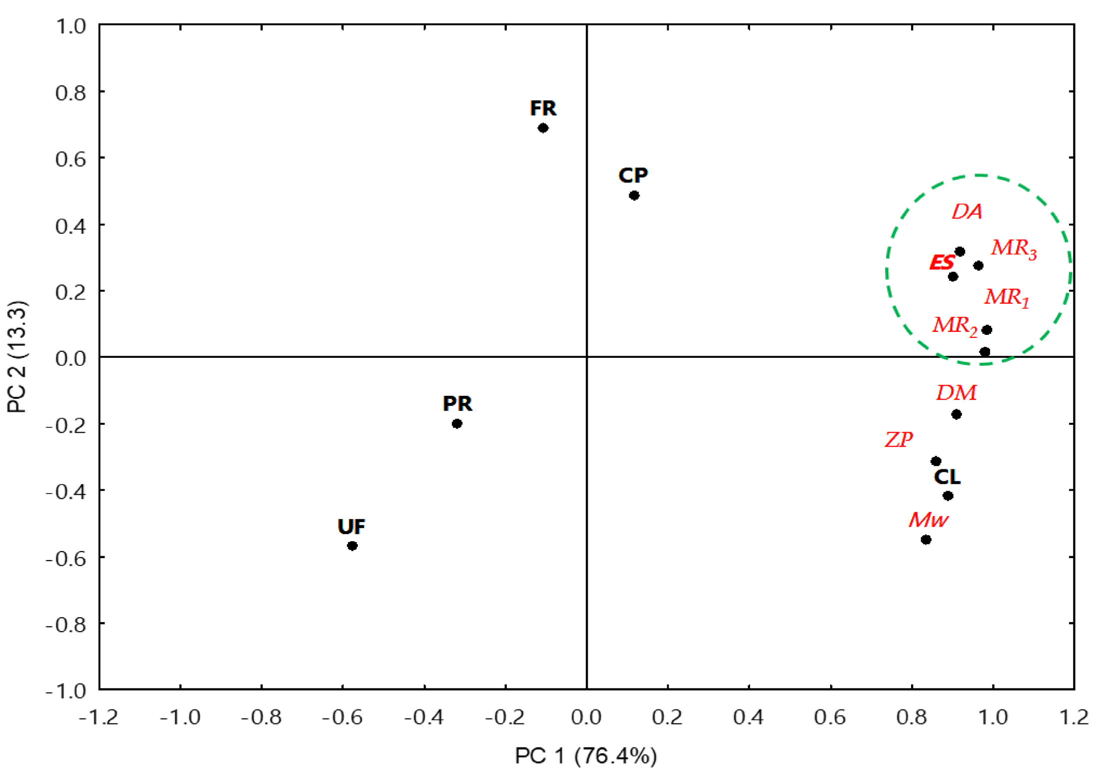


Fig. 5 Graphical illustration of structure-function relationship using PCA plot.
$MR_1$ = (Gal+Ara)/(Rha + GalA), $MR_2$ = Gal/(Rha + GalA), and $MR_3$ = Ara/(Rha + GalA)

- Okra pectins with diverse structures were obtained by simple enzymatic extraction.
- Variations observed in the emulsification performance of extracted pectins are directly linked to their structural compositions.
- The side-chain neutral sugar composition of OKP is a key indicator of emulsifying performance (Fig. 5)
- To achieve better emulsification performance, a tailored enzymatic extraction of okra pectin with a high molar ratio of side-chain sugars (Gal & Ara) is required
- The study's results highlight the potential to optimize the emulsification performance of okra pectins by tailoring the enzymatic extraction process.

## References

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